- **Testing instrument for photovoltaic installations**

GREENTEST-FTV 100

ENGLISH

User's manual

CHAUVIN® ARNOUX
CHAUVIN ARNOUX GROUP

FOREWORD

Thank you for purchasing this **GREEN TEST FTV 100**.

For best results from your instrument:

- **read** this operating manual carefully
- **observe** the safety precautions

Meanings of the symbols used on the instrument

	Selective disposal for the recycling of electric and electronic material required in the European Union. Under directive WEEE 2002/96/EC, this equipment must not be treated as a household waste.
	CAUTION - DANGER! Refer to the operating instructions. Failure to correctly observe or perform instructions in this manual preceded by this symbol may result in bodily injury or damage to the device and to the installations.
	Compliant with European Union directives.
	Device entirely protected by double insulation or reinforced insulation.
	USB port

PRECAUTIONS FOR USE

The instructions that follow are mandatory for correct use of the instrument. Failure to comply with these precautions may result in an electric shock, explosion, or fire.

- The user is invited to refer to these instructions whenever the symbol appears.
- Improper use of the instrument impairs its protection functions and may create a hazardous situation.
- When removing and installing the battery, make sure that the test leads, sensors, and power supply units are disconnected. The instrument must be disconnected and locked off.
- Responsibility for the safety of any installation built using this tool lies with the system assembler.
- For your safety, use only the compatible accessories and cables supplied with the instrument, in conformity with IEC standard 61010-031 (2002). When sensors or accessories having a lower voltage rating and/or category than the device are used, the lower voltage rating and/or category applies to the system so constituted.

- Before each use, check that the cables, housings, and accessories are in perfect condition. Any cable, sensor, or accessory of which the insulation is damaged (even partially) must be repaired or scrapped.
- Comply with the environmental conditions.
- We recommend using the personal protection equipment appropriate to the environmental conditions of use of the instrument.
- This tool can be used on class IV installations at voltages (AC or DC) not exceeding 600V referred to earth (IEC 61010-1) or on category III installations, at voltages not exceeding 1000V. Never use the instrument on networks of which the voltage or category exceeds those mentioned.
- Use the instrument only with the mains power supply unit or the battery pack supplied by the manufacturer. These units include specific safety devices.
- Observe the limits of physical protection of the equipment and sensors. Keep your hands away from unused terminals.

MEASUREMENT CATEGORIES

Definitions of the measurement categories according to EN-61010-1:

CAT I: Measurement category I corresponds to measurements taken on circuits not directly connected to the network.

CAT II: Measurement category II corresponds to measurements taken on circuits directly connected to the network.
Example: measurements on electrodomestic units, portable tools, and similar devices

CAT III: Measurement category III corresponds to measurements on building installations.
Example: measurements on distribution panels and wiring.

CAT IV: Measurement category IV corresponds to measurements taken at the source of low-voltage installations.
Example: meters and measurements on overvoltage protection devices.

REMARKS CONCERNING THIS MANUAL

- The information in this manual is subject to change without notice. The manufacturer cannot be held liable for any errors it may contain.
- Great care has been taken in the preparation of this manual, but should you, even so, have remarks to make, encounter difficulties in using our product, or have questions about it, please get in touch either with your dealer or with us.
- Make sure that you fully understand the conditions of use of the product, such as its hardware and software characteristics and its constraints of use. We cannot be held liable for damage caused by improper use of the device.
- Reproduction of this manual or of any part of it without our prior written permission is forbidden.\
- The names of products mentioned in this manual may be the trademarks, registered or not, of their respective owners.

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1. INTRODUCTION

The GREEN TEST FTV 100 is a measuring instrument designed and built to meet the needs of technicians during the installation, testing, certification, and maintenance of photovoltaic systems.

Photovoltaic systems comprise two parts:

- A **photovoltaic generator,** comprising one or more series of photovoltaic panels that generate a direct current.
- The **inverter** that converts the direct current generated by the panels into an alternating current that is supplied to the network for use.

The GREEN TEST FTV 100 has three inputs for measurements of the voltage (V_{DC}) and current (I_{DC}) delivered by the photovoltaic generator, making it possible to measure up to three series of solar panels at a time. Depending on the needs of the installation, you may use one input, two, or all three.
The other side of the instrument has three inputs for measurements of AC voltages (V_{AC}) and three for measurements of alternating currents (I_{AC}), making possible measurements on one, two, or three phases.
Make sure that the voltage and current connections are in phase, to avoid the acquisition of errored measurements.

The measurements available on the GREEN TEST FTV 100:

- measurement of solar radiation by pyranometer (up to 2000W/m²);
- measurement of outdoor temperature using a Pt100 probe (up to 80°C);
- measurement of the temperature of the solar panels using a Pt100 probe (up to 120°C);
- calculations of the theoretical power available;
- measurement of the voltage (1000V_{DC}), of the current (PAC10-FTV current clamps 200A_{DC}, PAC20-FTV current clamps 1400 A_{DC}) and of the power delivered by the solar panels;
- measurement of the voltage (600V_{AC}), of the current (MN-FTV current clamps 200A_{AC}, C107-FTV current clamps1000A_{AC}, D43-FTV current clamps 3000A_{AC}) and of the output power of the inverter;
- calculation of the efficiency of the solar panels with display of the values and highlighting of the test result;
- calculation of the DC/AC energy conversion (inverter) efficiency with display of the values and highlighting of the test result;
- Memory used to store customer data and system measurements;

2. CONTENT OF THE DELIVERY

Basic equipment	
Description	**Qty**
Pyranometer for solar radiation + connecting cable	1
Pt100 probe for the ambient temperature	1
Pt100 probe for the temperature of the panels	1

Optional equipment
Description
D43-FTV ammeter clamps for measurement of the alternating current (3000A_{AC})
C107-FTV ammeter clamps for measurement of the alternating current (1000A_{AC})
PAC10-FTV ammeter clamps for measurement of the direct current (200A_{DC})

MN-FTV ammeter clamps for measurement of the alternating current (200A_{AC})	3	PAC20-FTV ammeter clamps for measurement of the direct current (1400A_{DC})	
PAC10-FTV ammeter clamps for measurement of the direct current (200A_{DC})	1	FTV 100 remoted module + 2 male/male RS232 connectors	
Set of 3m leads (red/black)	4	Bluetooth communication kit (transmitter/receiver)	
Pairs of test probes (red/black)	4	15m serial cable with male/male RS232 connector	
4.5Ah Li-Ion battery	1	RS232/USB adapter	
Power supply unit	1	Alligator clips	
USB cable	1	No. 22 carrying bag	
Transport accessories	1		
Certificate of validation of the instrument	1		
CD-ROM containing: Operating manual of the Green Test FTV 100 Green Report V2.5 + instructions UpLoader 2.1 + instructions USB serial driver + instructions	1		

3. PRESENTATION

1. input 1: ammeter clamp A_{AC}
2. input 2: ammeter clamp A_{AC}
3. input 3: ammeter clamp A_{AC}
4. input 2: ammeter clamp A_{DC}
5. input 2: ammeter clamp A_{DC}
6. input 3: ammeter clamp A_{DC}
7. input 1: voltage V_{AC}
8. input 2: voltage V_{AC}
9. input 3: voltage V_{AC}
10. input 1: voltage V_{DC}
11. input 2: voltage V_{DC}
12. input 3: voltage V_{DC}
13. ambient temperature probe input
14. pyranometer input
15. solar panel temperature probe input
16. USB serial port (to PC)
17. RS232 serial port –to remoted unit)
18. multi-function alphanumeric keypad having the following keys:
    - ▲ "up" navigation key
    - ENTER selection validation key
    - ▼ "down" navigation key
    - ⏻ On/Off button
    - ESC menu exit key
    - DEL entry deletion key
19. input of external power supply (15V DC, 2A maximum consumed)
20. PWR ON/CHARGE FULL (only when an external power supply is connected); lights during recharging of the internal batteries or when they have reached full charge.
21. BAT Ch (only when an external power supply is connected); lights during the charging of the batteries.

4. SWITCHING ON/OFF

Pressing the ⏻ button for 1 second switches the instrument on.

Pressing the ⏻ button for 3 seconds when the instrument is on switches it off.

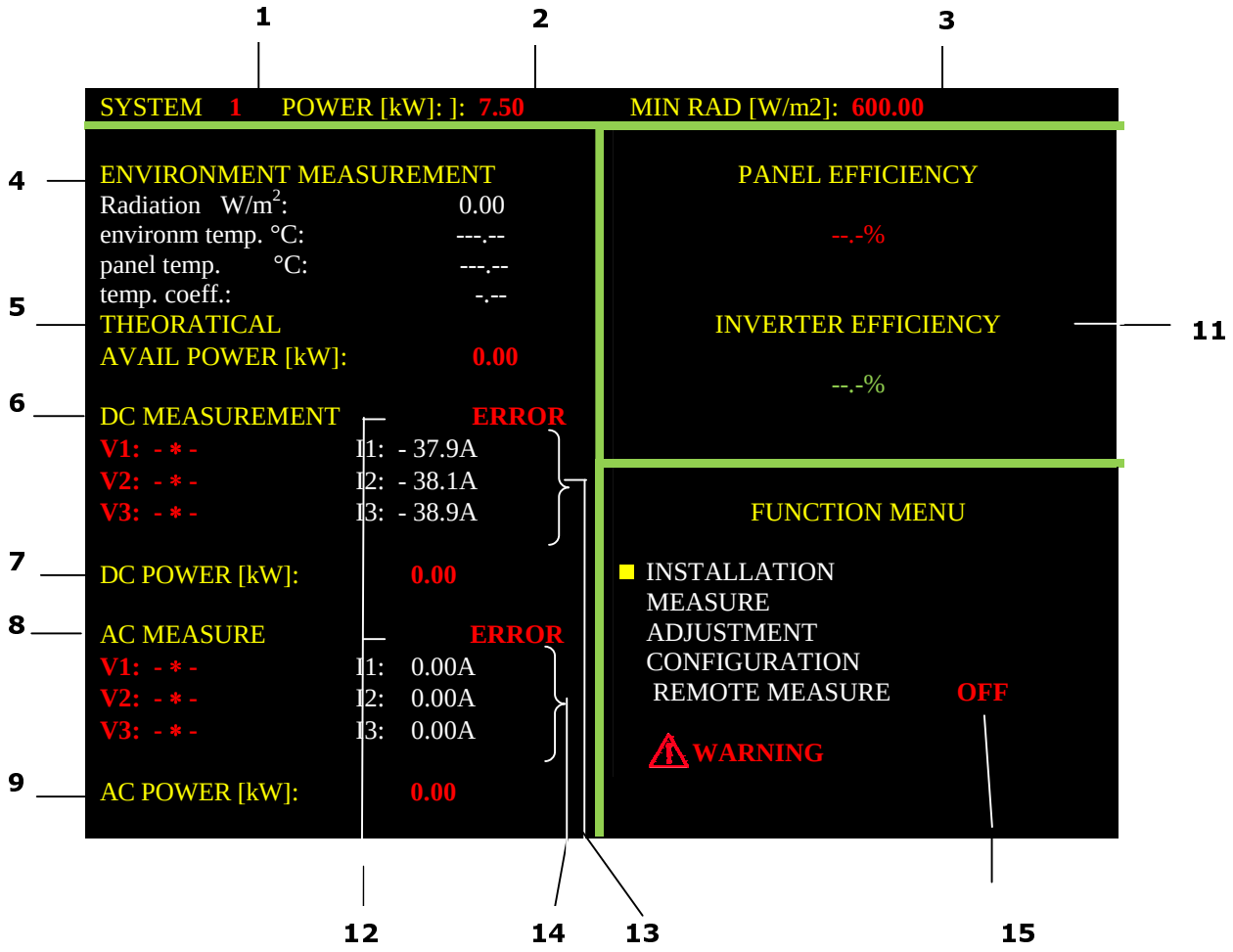
REMARK: *Pressing for more than one second when switching on may resulting in faulty lighting of the screen.*

If this happens, hold the ⏻ button down for more than 3 seconds, then switch the instrument back on.

The instrument can operate on battery power alone (without the external supply) if it is adequately charged, or when connected to the power supply unit.

5. PREPARING THE SCREEN

The GREEN TEST FTV 100 has a 5.7" LCD screen that displays all measurements and the results of the efficiency calculations in real time.



1. **IMP:** indicates the number of the photovoltaic installation selected
2. **POWER [kW]:** indicates the nominal power of the photovoltaic installation (value entered by the user).
3. **MIN RAD [W/m²]:** indicates the minimum insolation required for the performance calculations (see ADJUSTMENTS MENU). The default value is 600 W/m².
4. **ENVIRONMENT MEASURES:**

Radiation W/m²:	indicates the insolation measured by pyranometer (located on the panels and having the same inclination) (see also the directions for use of the pyranometer).
temp. environm ℃:	indicates the value of environme nt temperature measured by a Pt100 probe.
temp. panels ℃:	indicates the temperature of the solar panels measured by a Pt100 probe.
temp. coeff.:	indicates the panel performance correction parameter. This value changes when the temperature is above the data entered (NOCT). It is a constant 0.85 when the temperature is between 0℃ and the NOCT (normal operating cell temperature).

When it exceeds the NOCT, the coefficient falls below 0.85 and the panel loses efficiency (see page 34, §15.2).

The variation of the temperature coefficient also depends on the values entered for Gamma and for NOCT.

REMARK: *For all of the atmospheric measurements above, when the screen displays "---,--" with the text LOST (in red) at bottom right, communication has been broken off between the GREEN TEST instrument and the remoted module. This interruption may be because the batteries of the remoted module are discharged or because the signal has been lost (no Bluetooth link).*

5. THEORETICAL AVAILABLE POWER [kW]: theoretical power for an insolation of 1000 W/m² (value entered by the user, see SITE MENU – NEW SITE DATA).
6. DC MEASUREMENTS:

Display blank

V1: DC voltage or "- * -"	I1: direct current or -37.9A (-279.3A in 1.4kA version)
V2: DC voltage or "- * -"	I2: direct current or -38.1A (-279.8A in 1.4kA version)
V3: DC voltage or "- * -"	I3: direct current or -38.9A (-276.2A in 1.4kA version)

- * -: alert for each individual input (V1, V2, or V3):

- No connection to the PV system
- Voltage < $10V_{DC}$
- DC polarity reversed
- AC voltage on DC inputs (connection error)

The "**- * -**" symbol also flashes ⚠ **WARNING** is displayed at bottom right of the screen

7. **DC POWER [kW]:** indicates the measured direct current power from the solar generator.
8. **ALTERNATING CURRENT MEASUREMENTS:**

Display blank

V1: AC voltage or "- * -"	I1: alternating current (2.0A for the 3kA version)
V2: AC voltage or "- * -"	I2: alternating current (1.0A for the 3kA version)
V3: AC voltage or "- * -"	I3: alternating current (1.1A for the 3kA version)

- * -: alert for each individual input (V1, V2, or V3):

- No connection to the PV system
- Voltage < $25V_{AC}$

The "**- * -**" symbol also flashes ⚠ **WARNING** is displayed at bottom right of the screen

REMARK: *when connecting to the PV system, check that the phases correspond (V1-I1, V2-I2, etc.)*

9. **AC POWER [kW]:** indicates the measured AC output power of the inverter.
10. **EFFICIENCY OF PANELS:** indicates the efficiency of the photovoltaic generator as a percentage (%), along with all of the test results.

REMARK: *if Italian is the language selected for this device, under the provisions of standards applicable in Italy (DM19/02/2007, IEC guide 82-25), the results of the "Good/Bad" tests appear alongside the % efficiencies.*

In this case:

Measurements in percentage (%)	TEST RESULTS	REMARK
From ≥85% to 99.9%	OK	Value in percentage and "OK" displayed in steady green
From 0% to <85%	REJECTED	Value in percentage and "REJECTED" displayed in steady red
>99.9	"-----"	Flashing red dashes: anomaly, check the measurement parameters (power, current, voltage, insolation) and the connections of the photovoltaic system

11. **INVERTER EFFICIENCY** indicates the efficiency of the DC/AC conversion as a percentage and displays all checks.

REMARK: *if Italian is the language selected for this device, under the provisions of standards applicable in Italy (DM19/02/2007, IEC guide 82-25), the results of the "Good/Bad" tests appear alongside the % efficiencies.*
In this case:

Measurements in percentage (%)	TEST RESULTS	REMARK
From ≥90% to 99.9%	OK	Value in percentage and "OK" displayed in steady green
From 0% to <90%	REJECTED	Value in percentage and "REJECTED" displayed in steady red
>99.9	"----- "	Flashing red dashes: anomaly, check the measurement parameters (power, current, voltage, insolation) and the connections of the photovoltaic system

12. **ERROR**: indicates an alert in the following cases:

    - Wrong connections between the photovoltaic installation and the FTV 100, in the matching of the AC measurement phases (for example V1-I2, current clamps connected backwards) resulting in a negative AC power reading;

    - Wrong connections between the photovoltaic installation and the FTV 100, in the DC measurements part (current clamps connected backwards) resulting in a negative DC power reading.

13. **DC CURRENT (current clamps not connected):** Because of the great sensitivity of the inputs and their high impedances, the display unit indicates non-zero values. When a clamp is connected, this value can briefly reach (for the 200A clamp) I1 = -37.9A, I2 = -38.1A, I3 = -38.9A or (for the 1.4kA clamp) I1 = -279.3A, I2 = -279.8A, I3 = -276.2A) before falling back to zero.
    If low values remain displayed for a non-zero direct current when clamps are connected to the instrument, adjust the potentiometer to eliminate the residual magnetization of the ammeter causing the "ZERO" reading (see the instructions in the PAC current clamps manual).
14. **AC CURRENT (current clamps not connected):** When the instrument is switched on, the alternating current displayed is zero.
15. **OFF–ON–LOST INDICATIONS (REMOTE MEASUREMENT MENU)** set to point 15, these texts may indicate:

    OFF (red): If the remote module is used, it is possible to choose "with" or "without" the panel temperature probe (see ENVIRONMENT MEASUREMENT sub-menu);

    ON (red): The instrument is connected to the remoted module in the two cases anticipated (see ENVIRONMENT MEASUREMENT sub-menu);

    LOST (red): interruption of communication between the GREEN TEST instrument and the remoted module, because the batteries of the remoted module are discharged or the signal has been lost (no Bluetooth transmission).

    The response time of the instrument for the display of "Lost" is approximately 20 seconds.

    Communication is restored automatically only if the instrument and the remoted module are off (ON is displayed on the screen instead of LOST).

6. POWER SUPPLY

6.1 BATTERY LIFE BETWEEN CHARGES

The battery icon at bottom right on the screen indicates the charge level (proportional to the number of bars of the icon that are visible).

Battery full. Life: approximately 8 hours

Battery half-charged. Life: approximately 30 minutes

Battery discharged (symbol flashes). Life: approximately 10 minutes

6.2 CHARGING THE BATTERY

The battery is charged with the instrument off, using the mains adapter provided, connected to the corresponding jack. Even with the instrument connected to mains, you cannot charge the battery if the instrument is on.
We recommend using only the mains adapter supplied with the instrument. It is specially designed for it and ensures electric safety.
If the battery is fully discharged, the charging time is approximately 5 hours.

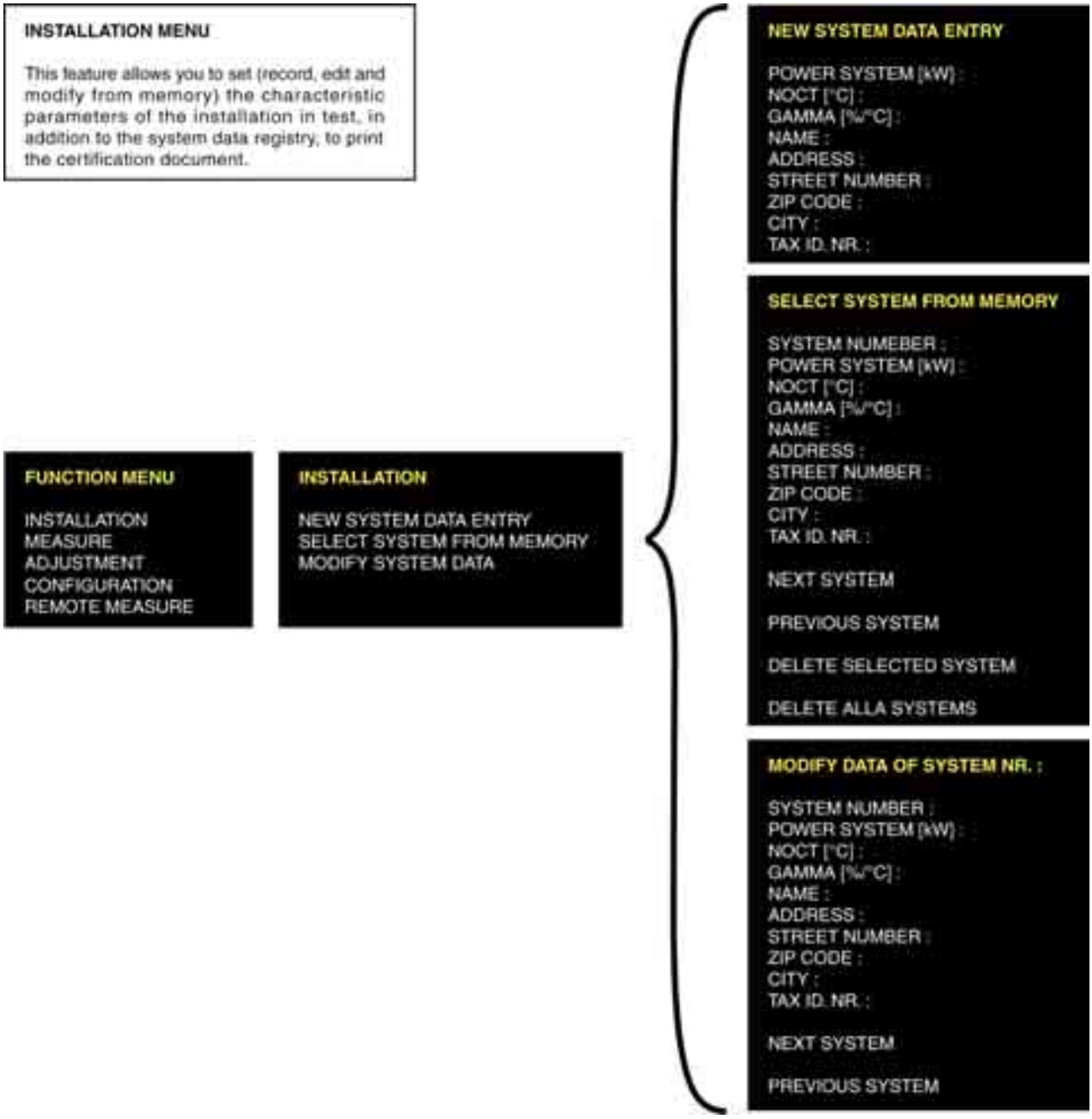
6.3 POWER SUPPLY

The power supply unit is compatible with voltages between 90V and 260V, at 50Hz. Its internal fuses are not accessible.

REMARK: *If the fuses blow, do not attempt to replace them, but send the power supply unit to Customer Service for inspection.*

7. MENU TREE

When the instrument is powered up, the "FUNCTIONS MENU" is displayed in the bottom right part of the screen.



MEASURE MENU

This feature allows you to access the selection and mesure acquisition menu.

FUNCTION MENU

INSTALLATION
MEASURE
ADJUSTMENT
CONFIGURATION
REMOTE MEASURE

MEASURE

MEASURE ACQUISITION
ACQUIRED MEASURE

MEASURE ACQUISITION

ENVIRONMENT AND DC
INVERTER
MEASURE CONFIRM
CANCEL

RECALL MEASURE FROM ARCHIVE

SYSTEM NUMBER :
POWER SYSTEM [kW] :
NOCT [°C] :
GAMMA [%/°C] :
NAME :
ADDRESS :
STREET NUMBER :
ZIP CODE :
CITY :
TAX ID. NR. :

NEXT SYSTEM

PREVIOUS SYSTEM

SELECTED SYSTEM MEASURE

ADJUSTMENT MENU

This feature allows you to access the menu for setting the instrument

FUNCTION MENU

INSTALLATION
MEASURE
ADJUSTMENT
CONFIGURATION
REMOTE MEASURE

ADJUSTMENT

PYRANOMETER

LOGO

DATE / TIME

POWER CALCULATION

LANGUAGE

DC MEASURE

AC MEASURE

MINIMUM RADIATION

CLAMPS SELECTION

PYRANOMETER

PYRANOMETER SENSITIVITY [mV/(kW/m2)]:

PRESENT VALUE : 14.08

LOGO

LOGO EDITING :

CURRENT LOGO : ---

DATE / TIME

YEAR :

MONTH

DAY

HOUR

MINUTE

SECOND

POWER CALCULATION

PANEL TEMPERATURE

ENVIRONMENT TEMPERATURE

LANGUE

DEUTSCH

ENGLISH

ESPAÑOL

FRANÇAIS

ITALIANO

FUNCTION MENU

INSTALLATION
MEASURE
ADJUSTMENT
CONFIGURATION
REMOTE MEASURE

ADJUSTMENT

PYRANOMETER
LOGO
DATE / TIME
POWER CALCULATION
LANGUAGE
DC MEASURE
AC MEASURE
MINIMUM RADIATION
AMPEREMETRIC CLAMPS

DC MEASURE

1
1+2
1+2+3

AC MEASURE

1
1+2
1+2+3

MINIMUM RADIATION

MINIMUM RADIATION [W/m²]

AMPEREMETRIC CLAMPS

CLAMPS FOR «IDC» MEASURES
PAC SERIES - 200A FULL SCALE
PAC SERIES - 1400A FULL SCALE

CLAMPS FOR «IAC» MEASURES
MN SERIES - 200A FULL SCALE
SERIE C - 1000A FULL SCALE
SERIE D - 3000A FULL SCALE

CONFIGURATION MENU

This feature allows you to access to instrument data, needed for service, updates and periodic checks.

FUNCTION MENU

INSTALLATION
MEASURE
ADJUSTMENT
CONFIGURATION
REMOTE MEASURE

CONFIGURATION

GREEN TEST FTV 100
SERIAL NUMBER :
SW VERSION :
VIDEO BOARD :

MEASURE REMOTE MENU

This feature allows you to access to instrument communication menu in LOCAL or in REMOTE with FTV100 unit.

FUNCTION MENU

INSTALLATION
MEASURE
ADJUSTMENT
CONFIGURATION
REMOTE MEASURE

ENVIRONMENT MEASURE

LOCAL
REMOTE WITHOUT T pan
REMOTE WITH T pan

8. DESCRIPTION OF THE MENUS

When the instrument is switched on and the main screen is displayed, the bottom right box contains the "FUNCTIONS MENU" with the main options. Each menu option selected gives access to one of the specific functions described below.
Emissivity:

8.1 USING THE ALPHANUMERIC KEYPAD

Proceed as follows to select the options of the "FUNCTIONS MENU":

- Place the yellow cursor on the desired option using the • or •arrow key;
- Press the **ENTER** button to confirm each selection;
- Then enter the data using the alphanumeric keys, bearing in mind that by continuing to press the same button you select the corresponding letters and figures;
- Press **ENTER** again to validate your entry.

8.2 SITE MENU

8.2.1 NEW SITE DATA

This function is used to adjust the parameters of the installation being checked, in addition to the register of data concerning the sites, to print the certification document.
You can configure up to 20 sites in the memory of the instrument, each of which can acquire a maximum of 12 measurement reports (certifications).
REMARK: *since the data concerning the POWER of the site, the SENSITIVITY of the pyranometer, and the NOCT and GAMMA parameters are used for the efficiency calculations, make sure to enter the correct values to avoid vitiating the calculations.*

- Power of the site [kW]: indicates the theoretical power of the site;
- NOCT [°C]: nominal operating temperature of the cell (data provided by the manufacturer of the panels);
- GAMMA g [%/°C]: power vs. temperature coefficient of the PV module (value entered between 0.01 and 0.99) (data provided by the manufacturer of the panels)

REMARK: *enter the unsigned numerical value "+" or "-";*

- Name: indicates the name of the site;
- Address (street and number), postal code and Town: indicate the address of the site;
- Code: indicates the customer's tax file number;
- Select CONFIRMATION and wait for the data entered to be recorded.

REMARK: *the data entered are recorded only if the power of the site, NOCT, and GAMMA have been entered correctly.*

8.2.2 A LOOK AT THE THEORY

One characteristic of the photovoltaic panels used, **the parameter γ** (gamma), is generally indicated by the manufacturer of the panels. For modules made of crystalline silicon, it is generally 0.4-0.5%°C (to enter the value of g, refer to the description of the NEW SITE DATA MENU).
The NOCT parameter is characteristic of the photovoltaic panels used. It too is indicated by the manufacturer of the panels. For modules made of crystalline silicon, it is generally between 40°C and 50°C.
Temperatures Tamb and Tcel are used in the calculations by the GREEN TEST FTV 100 **and are measured by a Pt100 temperature probe.**

- **Tcel**, which is the cell temperature of a PV module, can be measured using a thermoresistive sensor directly connected to the instrument or using the remoted FTV 100 module.
- **Tamb** is the ambient temperature, which can be measured using a sensor connected directly to the instrument or using a remoted FTV 100 module (the probe is generally placed in the shade).

In the measurement of P_{DC}, if an operating temperature **≥40°C** is measured on the backs of the modules, a temperature correction of the site itself is allowed.

In this case, the relation **Pcc > 0.85 x Pnom x I/Istc** becomes:
P_{DC} > (1 – Ptpv – 0.08) x Pnom x I/Istc
where Ptpv corresponds to the thermal losses of the photovoltaic generator.

Several practices exist. It is possible to select two types of mathematical relation to calculate the correction factor.
The temperature of the photovoltaic cells being known, this parameter is calculated using the relation:

Ptpv = (Tcel – 25) x γ

Or, **from the ambient temperature**, by:

Ptpv = [Tamb - 25 + (NOCT – 20) x I/0,8] x γ

8.2.3 SELECT A SITE

This function is used to select the data of a photovoltaic site stored in memory. This configuration is used to perform the measurements and as reference for a possible printed report.
This menu includes the following commands:

- NEXT SYSTEM

Press **ENTER** to go to the next recorded site

- PREVIOUS SYSTEM

Press **ENTER** to go to the previous recorded site

- ERASE SITE

Press **ENTER** to erase the selected site from memory

- ERASE ALL SITES

Press **ENTER** to erase all sites stored in memory

8.2.4 MODIFY A SITE

This function lets you modify the data of a site entered previously.
To make modifications, place the cursor on the line concerned and press **ENTER**, enter the new value, and press **ENTER** again to confirm the modification.
Press **ESC** to confirm the modifications and update the data in memory.

8.3 MEASUREMENT MENU

8.3.1 MEASUREMENT ACQUISITION

Each of the 20 sites can acquire up to 12 measurement reports (certifications).
Press **ENTER** to select the measurements to be acquired.

- **ENVIRONMENT AND DC**

Press **ENTER** to select the ENVIRONMENT and DC measurements of the photovoltaic generator (a red asterisk "*" appears on the element selected).
To confirm the storage of the selected measurements, place the cursor on **CONFIRM MEASUREMENT** and press **ENTER**.

- **INVERTER**

Press **ENTER** to select the INVERTER measurements (DC and AC side) (a red asterisk "*" appears on the element selected).
To confirm the storage of the selected measurements, place the cursor on CONFIRM MEASUREMENT and press **ENTER**.

- **ALL MEASUREMENTS**

Press **ENTER** to select the ENVIRONMENT AND DC and INVERTER measurements (DC and AC side) (a red asterisk "*" appears on the element selected).
To confirm the storage of the measurements selected, place the cursor on CONFIRM MEASUREMENT and press **ENTER**.

- **CANCELLED**

Press **ENTER** to cancel the selections made previously.

8.3.2 MEASUREMENT ACQUIRED

Press **ENTER** to display the option **RECOVERY OF STORED MEASUREMENTS**, that corresponds to the data of the sites stored in memory.

- **NEXT SITE**

Press **ENTER** to display the data of the site after the one currently displayed.

- **PREVIOUS SITE**

Press **ENTER** to display the data of the site before the one currently displayed.

- **MEASUREMENT OF THE SITE SELECTED**

Press **ENTER** to display all measurements of the selected system, with the test results (**OK** or **REJECTED**):

This menu includes the following commands:

- **NEXT MEASUREMENT**

Press **ENTER** to display the measurements of the site after the one currently displayed.

- **PREVIOUS MEASUREMENT**

Press **ENTER** to display the measurements of the site before the one currently displayed.

- **ERASE THE SELECTED MEASUREMENTS**

Press **ENTER** to erase the measurements of the selected site.

- **ERASE ALL MEASUREMENTS**

Press **ENTER** to erase the measurements of all sites stored in memory.

(*) for the efficiency calculation, a minimum insolation of 600W/m² or more on the plane of the modules (gamma) is recommended. A radiation threshold can be assigned in the Adjustments menu.

8.4 ADJUSTMENTS MENU

Press **ENTER** to display the ADJUSTMENTS menu, which includes the following elements:

- **PYRANOMETER**

Press **ENTER** to select the SENSITIVITY OF THE PYRANOMETER (value expressed in [mV/(kW/m2)] and displayed on the panel of the pyranometer) if it differs from the assigned value (see: standard sensitivity value) or in the event of replacement.
Press **ENTER** to enter the sensitivity value.
Press **ENTER** again to validate the value entered.

- **LOGO (NAME OF THE COMPANY THAT CERTIFIED THE SITE)**

Press **ENTER** to select INSERTION OF THE LOGO.
Press **ENTER** to enter the abbreviated name of the installer company that makes the measurement or to replace the name already entered.
Press **ENTER** again to validate the name entered.

- **DATE/TIME**

Press **ENTER** to select **DATE/TIME**.
Place the cursor on each field; press **ENTER** to enter a value (numerical only).
Press **ENTER** again to confirm the value entered.
Place the cursor on **CONFIRMATION** and press **ENTER** to record the data in memory.

REMARK: *the data will appear in the certification documents.*

- **POWER CALCULATION**

Press **ENTER** to select **POWER CALCULATION**.
This function is used to calculate the power with allowance for the Ptpv losses due to the reduction of performance of the photovoltaic generator as a function of AMBIENT TEMPERATURE (Tamb) or of PANEL TEMPERATURE (Tcel),
Place the cursor on the desired option and press **ENTER** to select it (a red asterisk "*" appears on the option chosen).

- **LANGUAGE**

Press **ENTER** to select **LANGUAGE**.
Place the cursor on the desired option and press **ENTER** to select it (a red asterisk "*" appears on the option chosen).

- **DC MEASUREMENT**

Press **ENTER** to select **DC MEASUREMENT**.
Place the cursor on the desired option and press **ENTER** to select a type of site on the DC side (a red asterisk "*" appears on the option chosen).
Example: 1 = site with one chain, 1+2 = system with two chains, 1+2+3 = system with three chains.

- **AC MEASUREMENT**

Press **ENTER** to select **AC MEASUREMENT**.
Place the cursor on the desired option and press **ENTER** to select a type of site on the AC side (a red asterisk "*" appears on the option chosen).
Example: 1 = site with one chain, 1+2 = system with two chains, 1+2+3 = system with three chains.

- **MINIMUM INSOLATION**

Press **ENTER** to select **MINIMUM INSOLATION** (W/m2).
Press **ENTER** to enter the minimum insolation used for the efficiency calculation.
Press **ENTER** again to validate the value entered.

- **CURRENT CLAMPS**

Press **ENTER** to select the **"CURRENT CLAMPS"** MENU**.**
Move the cursor to the desired IDC clamp model and press **ENTER** to validate your choice (a red asterisk "*" appears on the option chosen).
Move the cursor to the desired IAC clamp model and press **ENTER** to validate your choice.
(a red asterisk "*" appears on the option chosen).

8.5 CONFIGURATION

Press ENTER to display the data of the instrument for updates and periodic checks:

- Serial number;
- Microprogram version installed;
- Version of video board.

8.6 REMOTE MEASUREMENT

Press **ENTER** to select **REMOTE MEASUREMENT**.
Place the cursor on the desired option and press ENTER to select the type of measurement.

- **LOCAL**

Press **ENTER** to select use of the local atmospheric input values present in the instrument, without the help of the remoted FTV 100 module
(a red asterisk "*" appears on the option chosen).
A test of communication with the remoted module is performed. An indication, **OK** or **REJECTED,** appears at the end of not more than 30 seconds (...Loading, flashing).
On the main screen, the REMOTE MEASUREMENT indication changes to **ON**.

The following functions can be activated only with the remoted FTV 100 module on and connected by the optional communication kit (cable or Bluetooth).

- **REMOTE WITHOUT T pan**

Press **ENTER** to select use of the local atmospheric input values present on the remoted FTV 100 module, without the AMBIENT TEMPERATURE value
(a red asterisk "*" appears on the option chosen).
The texts **OK** or **REJECTED** that appear at the end of 30 seconds (...LOADING, flashing) indicate the result of the link with the data of the remoted FTV 100 module, and are confirmed on the main screen, to the right of REMOTE MEASUREMENT, by **ON** or **REJECTED**.

- **REMOTE WITH T pan**

Press **ENTER** to select the use of the local atmospheric input values present on the remoted FTV 100 module, with the AMBIENT TEMPERATURE value
(a red asterisk "*" appears on the option chosen).
The texts **OK** or **REJECTED** that appear at the end of 30 seconds (...LOADING, flashing) indicate the result of the link with the data of the remoted FTV 100 module, and are confirmed on the main screen, to the right of REMOTE MEASUREMENT, by **ON** or **REJECTED**.

8.7 LOCATIONS OF THE MEASUREMENT POINTS ON THE PHOTOVOLTAIC PANELS

1. Pyranometer
2. Panel temperature probe
3. Ambient temperature probe
4. Photovoltaic panel
5. DC current clamp
6. Inverter
7. Electric meter
8. Electric line

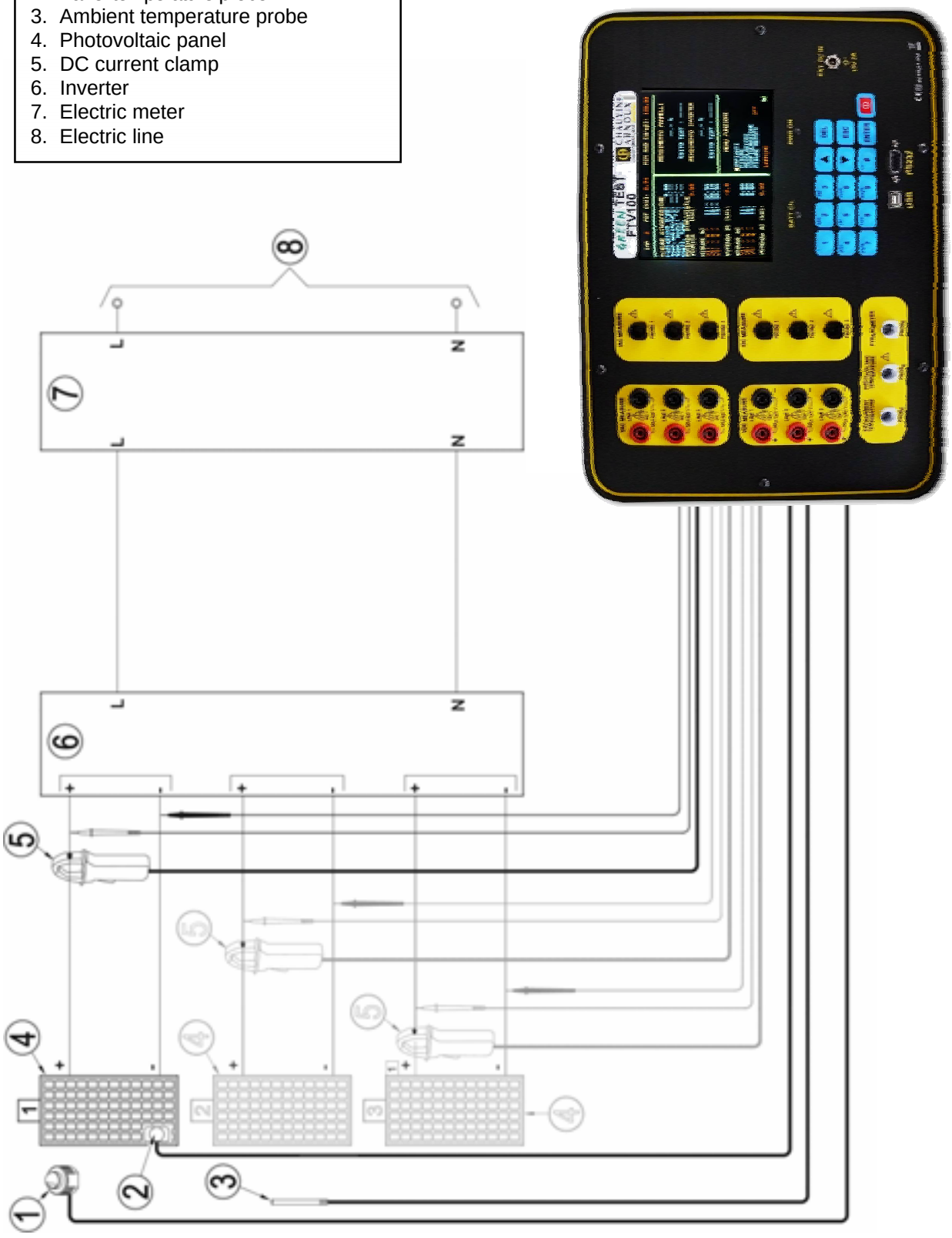


Figure 1: Locations of the measurement points on the photovoltaic panels

See Figure 1: Locations of the measurement points on the photovoltaic panels.

To make the measurements and determine the efficiency of the photovoltaic generator, proceed as follows:

1. Connect the VDC MEASURE LINE1 voltage inputs to the DC voltage output of the photovoltaic panel using the cables provided, respecting the polarity;
2. Connect the DC current clamp, IDC MEASURE PROBE1, to the positive or negative cable of the DC output of the photovoltaic panel. Note that the clamp is sensitive to the direction of the current measured;
3. Activate the clamp;
4. Connect the pyranometer to the PYRANOMETER input. The pyranometer measures the insolation;
5. Connect the ambient temperature probe to the AMBIENT TEMPERATURE input. Place the probe near the photovoltaic panel;
6. Connect the contact probe to the PANEL TEMPERATURE input. Place the probe in thermal contact with the photovoltaic panel.

8.8 MEASUREMENT ACQUISITION

Refer to the MEASUREMENT MENU: MEASUREMENT ACQUISITION

8.9 LOCATIONS OF THE MEASUREMENT POINTS ON A SINGLE-PHASE INVERTER

1. Photovoltaic panel
2. DC current clamp
3. Inverter
4. AC current clamp
5. Electric meter
6. Electric line

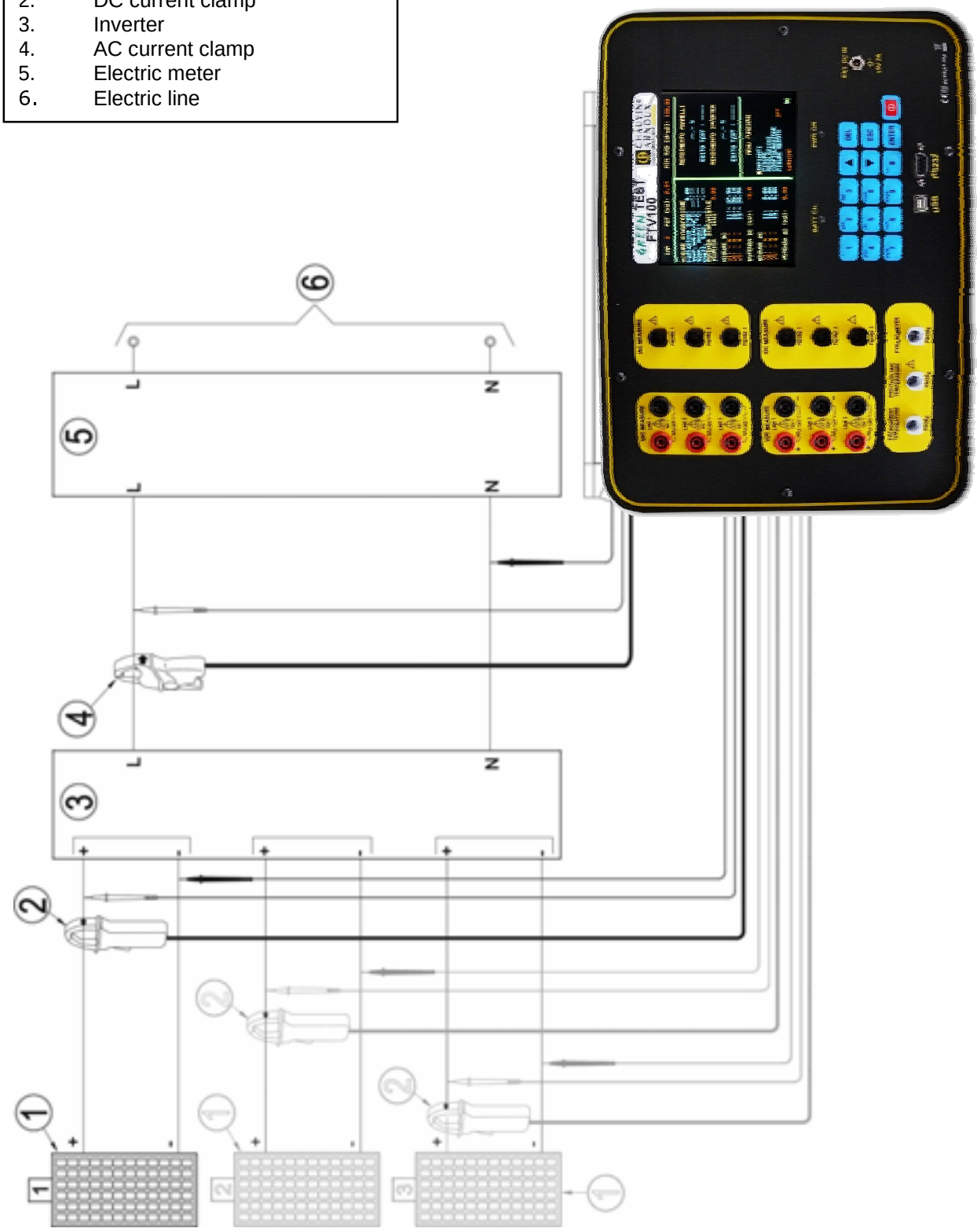


Figure 2: Locations of the measurement points on a single-phase inverter

See Figure 2: Locations of the measurement points on a single-phase inverter.

To measure the efficiency of a single-phase inverter, proceed as follows:

1. Connect the **VDC MEASURE LINE1** voltage inputs to the DC voltage output of the photovoltaic panel using the cables provided, respecting the polarity;
2. Connect the DC current clamp to the **IDC MEASURE PROBE1** input and to the positive or negative cable of the DC output of the photovoltaic panel. Note that the clamp is sensitive to the direction of the current measured;
3. Connect the **VAC MEASURE LINE1** voltage inputs to the AC voltage output of the inverter using the cables provided;
4. Connect the AC current clamp to the **IAC MEASURE PROBE1** input and to the alternating current output cable of the inverter.

8.10 MEASUREMENT ACQUISITION

Refer to the MEASUREMENT MENU: MEASUREMENT ACQUISITION

8.11 CONNECTIONS OF THE MEASUREMENTS OF THE COMPLETE SITE WITH SINGLE-PHASE OUTPUT

Pyranometer
2. Panel temperature probe
3. Ambient temperature probe
4. Photovoltaic panel
5. DC current clamp
6. Inverter
7. AC current clamp
8. Electric meter
9. Electric line

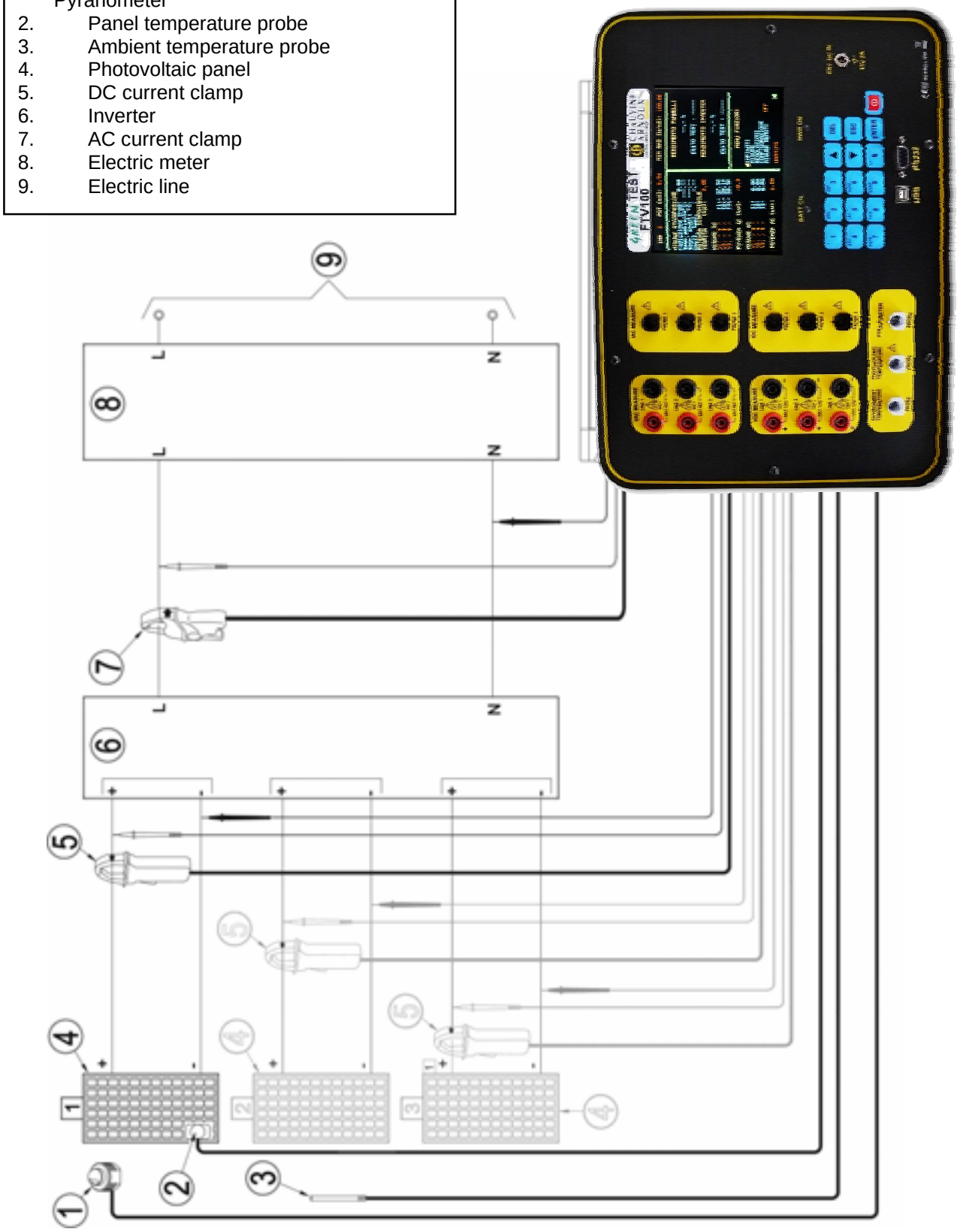


Figure 3: Connections of the measurements of the complete site with single-phase output

See Figure 3: Connections of the measurements of the complete site with single-phase output

The measurements described in the previous chapters can be made simultaneously.

1. Connect the VDC MEASURE LINE1 voltage inputs to the DC voltage output of the photovoltaic panel using the cables provided, respecting the polarity;
2. Connect the DC current clamp to the IDC MEASURE PROBE1 input and to the positive or negative cable of the DC output of the photovoltaic panel. Note that the clamp is sensitive to the direction of the current measured;
3. Activate the DC clamp;
4. Connect the pyranometer to the PYRANOMETER input. The pyranometer measures the insolation;
5. Connect the ambient temperature probe to the AMBIENT TEMPERATURE input. Place the probe near the photovoltaic panel;
6. Connect the contact probe to the PANEL TEMPERATURE input. Place the probe in thermal contact with the photovoltaic panel;
7. Connect the VAC MEASURE LINE1 voltage inputs to the AC voltage output of the inverter using the cables provided;
8. Connect the AC current clamp to the IAC MEASURE PROBE1 input and to the alternating current output cable of the inverter.

8.12 MEASUREMENT ACQUISITION

Refer to the MEASUREMENT MENU: MEASUREMENT ACQUISITION

8.13 LOCATIONS OF THE MEASUREMENT POINTS ON A THREE-PHASE INVERTER

1. Photovoltaic panel
2. DC current clamp
3. Inverter
4. AC current clamp
5. Electric meter
6. Electric line

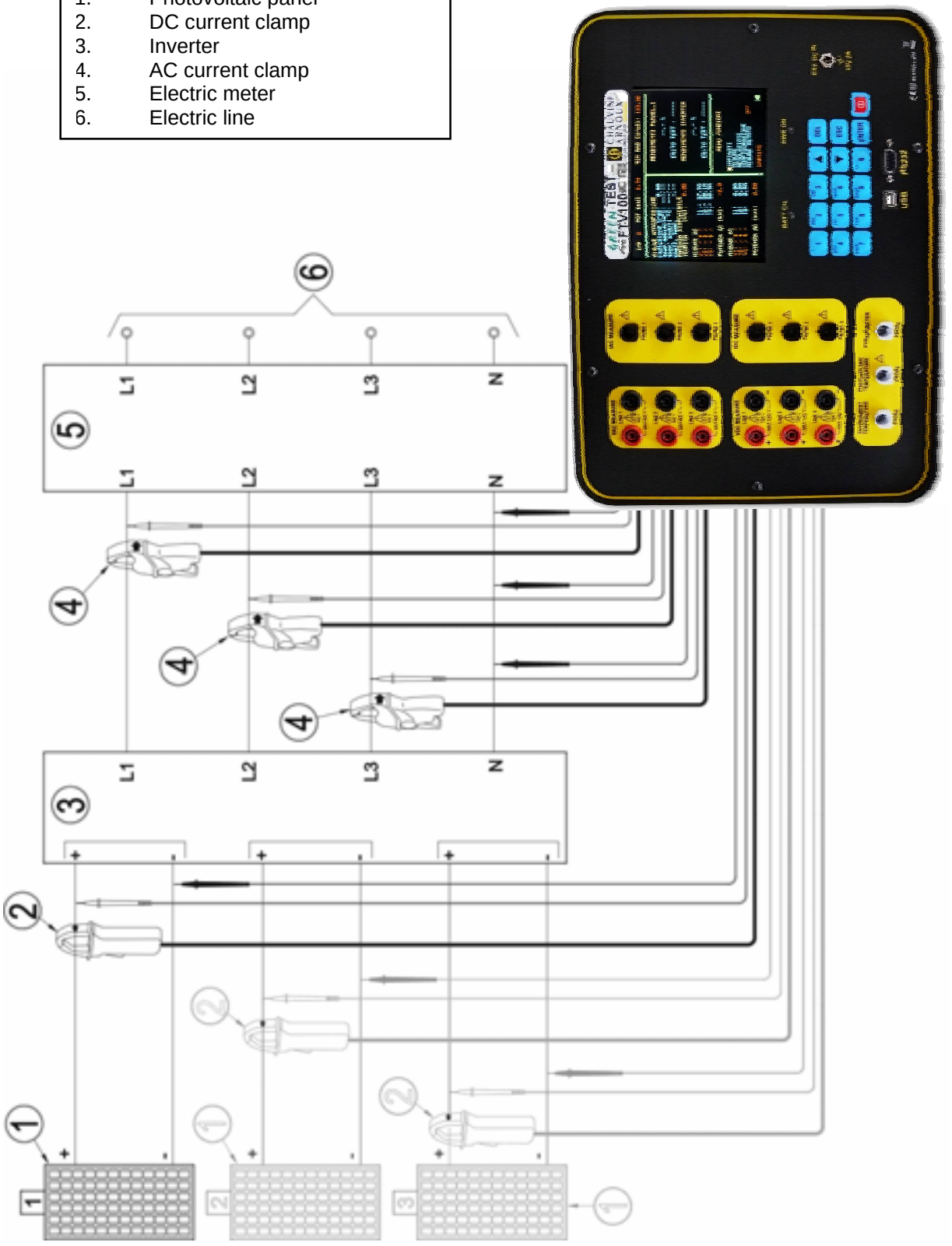


Figure 4: Locations of the measurement points on a three-phase inverter

See Figure 4: Locations of the measurement points on a three-phase inverter.

1. Connect the **VDC MEASURE LINE1** voltage inputs to the DC voltage output of the photovoltaic panel using the cables provided, respecting the polarity;
2. Connect the DC current clamp to the **IDC MEASURE PROBE1** input and to the positive or negative cable of the DC output of the photovoltaic panel. Note that the clamp is sensitive to the direction of the current measured;
3. Activate the DC clamp;
4. Connect the **VAC MEASURE LINE1- LINE2- LINE3** voltage inputs to the AC voltage output of the inverter using the cables provided;
5. Connect the AC current clamp to the **IAC MEASURE PROBE1- PROBE1- PROBE1** input and to the alternating current output cable of the inverter.

N.B.: *AC side: check that the phases exactly match in the connection between the inputs of the voltmeter and of the ammeter:*

VAC MEASURE LINE1 → IAC MEASURE PROBE1 phase L1,
VAC MEASURE LINE2 → IAC MEASURE PROBE2 phase L2,
VAC MEASURE LINE3 → IAC MEASURE PROBE3 phase L3,

8.14 MEASUREMENT ACQUISITION

Refer to the MEASUREMENT MENU: MEASUREMENT ACQUISITION

8.15 CONNECTIONS OF THE MEASUREMENTS OF THE COMPLETE SITE WITH THREE-PHASE OUTPUT

1. Pyranometer
2. Panel temperature probe
3. Ambient temperature probe
4. Photovoltaic panel
5. DC current clamp
6. Inverter
7. DC current clamp
8. Electric meter
9. Electric line

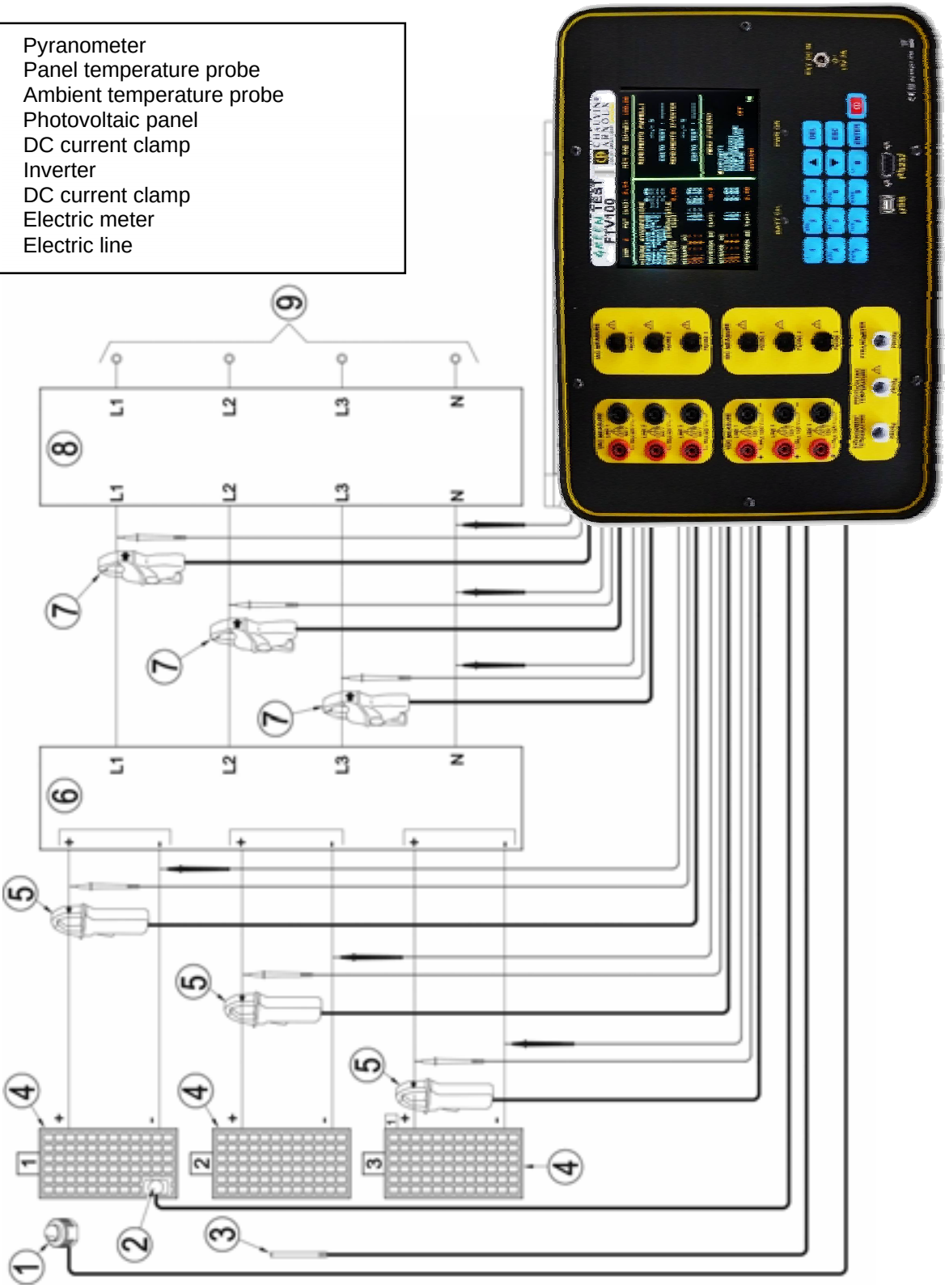


Figure 5: Connections of the measurements of the complete system with three-phase output

See Figure 5: Connections of the measurements of the complete system with three-phase output.

1. Connect the **VDC MEASURE LINE1** voltage inputs to the DC output voltage of the photovoltaic panel using the cables provided, respecting the polarity;
2. Connect the DC current clamp to the **IDC MEASURE PROBE1** input and to the positive or negative cable of the DC output of the photovoltaic panel. Note that the clamp is sensitive to the direction of the current measured;
3. Activate the DC clamp;
4. Connect the pyranometer to the PYRANOMETER input. The pyranometer measures the insolation;
5. Connect the ambient temperature probe to the AMBIENT TEMPERATURE input. Place the probe near the photovoltaic panel;
6. Connect the probe to the **PANEL TEMPERATURE**. Place the probe in thermal contact with the photovoltaic panel;
7. Connect the **VAC MEASURE LINE1-LINE2-LINE3** voltage inputs to the AC voltage output of the inverter using the cables provided;
8. Connect the AC current clamp to the **IAC MEASURE PROBE1- PROBE1- PROBE1** input and to the alternating current output cable of the inverter.

N.B.: *AC side: check that the phases exactly match in the connections between the inputs of the voltmeter and of the ammeter:*

VAC MEASURE LINE1 → IAC MEASURE PROBE1 phase L1,
VAC MEASURE LINE2 → IAC MEASURE PROBE2 phase L2,
VAC MEASURE LINE3 → IAC MEASURE PROBE3 phase L3,

8.16 MEASUREMENT ACQUISITION

Refer to the MEASUREMENT MENU: MEASUREMENT ACQUISITION

8.17 MEASUREMENT OF THE COMPLETE SITE IN TWO SEPARATE STAGES

Practice has taught us that the measurements of PCC, PCA, Gp, and Tamb used in the performance calculations should be acquired simultaneously.
It is however possible to perform the checks in two stages (DC side and AC side), provided that the insolation, temperature, and output power remain practically constant during the measurement.

HOW TO MAKE THE MEASUREMENT USING THE GREEN TEST FTV 100

DC SIDE (PHOTOVOLTAIC PANEL)

Stand facing the photovoltaic panels and connect the instrument as indicated by the "**connection diagram for the measurement of photovoltaic panels (§ 8.7)".**

In the FUNCTIONS MENU - MEASUREMENT, select MEASUREMENT ACQUISITION and place the cursor on **ENVIRONMENT** and **DC**.
Check the connections to the system and press ENTER to acquire the measurements (an "*" and the flashing text, CURRENT ACQUISITION..., indicate that the operation is in progress).

Leave the GREEN TEST FTV 100 on, disconnect it from the DC part of the installation, and acquire the measurements on the AC side downstream of the inverter.

AC SIDE (INVERTER)

Connect the instrument to the downstream side of the inverter and connect the instrument as indicated by the "**measurements connection diagram, single-phase inverter side (page 21)"** or the **"measurements connection diagram, three-phase inverter side (page 25)"**.

In the FUNCTIONS MENU - MEASUREMENT, select MEASUREMENT ACQUISITION and place the cursor on **INVERTER**.
Check the connections to the system and press ENTER to acquire the measurements (an “*” and the flashing text CURRENT ACQUISITION... indicate that the operation is in progress).

To confirm the recording of the DC side and AC side measurements acquired, place the cursor on **CONFIRM MEASUREMENT** and press **ENTER** (the text **STORING MEASUREMENT...** flashes to indicate that the operation is in progress).

8.18 COMMUNICATION INTERFACE

The standard GREEN TEST FTV 100 has an RS232 interface (9-pin D-SUB), a USB interface, and enough memory to store approximately 200 sets of measurement (one main measurement + secondary measurements: voltage, current, power, atmospheric data, date, time, etc.).
The instrument includes a real-time clock for the date and the time.
The USB interface is used to process and transfer the stored data to a PC running GREEN REPORT software.

8.18.1 RS232 INTERFACE - TECHNICAL CHARACTERISTICS

Data format: 1 start bit, 8 data bits, 1 stop bit, no parity, no protocol
Rate: 38,400 bauds

8.18.2 USB INTERFACE - TECHNICAL CHARACTERISTICS

Protocol v.2.0. If no communication is detected, please contact our Customer Service for the installation of the driver.
The USB interface is also used to update the internal microprogram of the instrument (contact us for more information).

8.19 "GREEN REPORT" SOFTWARE

The GREEN REPORT software on the CD-ROM provided is used for the following operations:

- remote management;
- management of the measurements stored on the instrument;

- printing of measurement reports and of the declaration of conformity issued at the end of the tests of the site;
- real-time analysis of all measurements (manual or automatic) of the PV system;
- graphic display of all measurements of the PV system vs. time.

8.19.1 GREEN REPORT SOFTWARE INSTALLATION PROCEDURE

1. Insert the CD-ROM provided in the drive of the PC;
2. Click on the GREEN REPORT folder. When you have opened the folder, open the PDF instruction file it contains and follow the instructions to ensure correct installation of the GREEN REPORT software;
3. Once installed, the GREEN REPORT software is ready to be used.

8.19.2 FUNCTIONS OF THE GREEN REPORT SOFTWARE

GREEN REPORT has several icons that represent its functions.

8.19.2.1 CONFIGURATION

By clicking on this icon, you can check the status of communication between the instrument (base unit) and the remoted module.
Access to the CONFIGURATION function lets you perform the following operations:

- selection of the power calculation method (see the ADJUSTMENTS menu);
- selection of the number of DC inputs (current, voltage);
- selection of the number of AC inputs (current, voltage);
- selection of the minimum insolation for the efficiency calculation (very important if you want to perform tests with an insolation of less than 600 W/m².

8.19.2.2 CONNECTION OF THE INSTRUMENT TO THE PC:

1. To transfer the data acquired to the PC, connect the instrument to the PC using the USB cable:
   - Click on the "CONFIGURATION" icon.
   - Select the COM port of the device in the pull-down menu (if the COM port number does not appear, look for it in the Windows Peripherals Manager).
   - Click on “CONNECT THE BASE UNIT”.
   - Wait for CONNECTION STATUS to be displayed:
     - Green light (connection established);
     - Red light (no connection).
2. Acquisition of measurements in REAL TIME in LOCAL mode
   - Connect the instrument to the PC using the USB cable.
   - Click on the "CONFIGURATION" icon.
   - Select the COM port of the device in the pull-down menu (if the COM port number does not appear, look for it in the Windows Peripherals Manager).
   - Click on "CONNECT THE BASE UNIT".
   - Wait for CONNECTION STATUS to be displayed:
     - Green light (connection established);
     - Red light (no connection).
   - Click on the REAL TIME icon (refer to the description of the REAL TIME menu).

3. Remote acquisition of measurements in REAL TIME from the remoted module:
   - Connect the instrument to the PC using the USB cable.
   - Connect a Bluetooth adapter to the PC using the RS232 cable provided.
   - Connect the other Bluetooth adapter to the remoted module using the RS232 cable provided.
   - Click on the "CONFIGURATION" icon.
   - Select the COM port of the device in the pull-down menu (if the COM port number does not appear, look for it in the Windows Peripherals Manager).
   - Click on "CONNECT THE BASE UNIT".
   - Wait for CONNECTION STATUS to be displayed:
     - Green light (connection established);
     - Red light (no connection).
   - Click on "CONNECTION OF REMOTE MODULE".
   - Select REMOTE MEASUREMENT on the instrument and choose the type of measurement to be made: REMOTE WITH T pan (when you use a PT100 probe on the solar panels) or REMOTE WITHOUT T pan (if you do not use a PT100 probe for the solar panels).
   - Press the ENTER key and wait for the OK message (if REJECTED is displayed, check the connections and repeat the procedure).
   - Press the ESC key to exit from the menu.
   - Click on the REAL TIME icon (see the description of the menu of that name).

8.19.2.3 "REPORT"

This icon is used to select the SITE in the data base of the instrument or on the PC and the measurements to be used to create the declaration and the system measurement sheet, along with the results of the efficiency calculation.
The declaration is generated only if the result of the tests is OK. If not, only the measurement sheet is generated.

8.19.2.4 "REAL TIME"

This icon is used to display in real time the measurements of the site in question (atmospheric measurements, DC, AC, efficiencies, etc.), either manually or automatically at a predetermined date and time. The data can be recorded in a TXT format and exported to spreadsheets.

8.19.2.5 "DATA ACQUIRED"

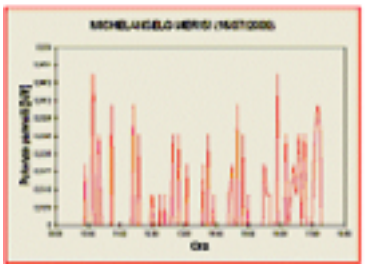
This icon is used to display the data of your sites, whether or not stored on the GREEN TEST FTV 100, along with the data present in the PC's database, and create graphs of all quantities vs. time.
Analysis of these graphs is a very important aspect of the maintenance of your photovoltaic systems.

8.19.2.6 "INSTALLATIONS"

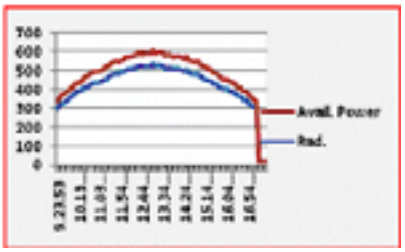
This icon is used to add a new site or to delete one from your PC's database.

8.19.3 EXAMPLES OF GRAPHS CREATED BY "GREEN REPORT" SOFTWARE

Exemple de graphique d'une seule valeur mesurée (puissance disponible théorique)



Exemple de graphique des plus grandes valeurs mesurées (puissance disponible théorique/ensoleillement)



9. REPORT ON STATUSES AND MEASUREMENTS

The test is intended to prove and certify that the installation has been built in a professional manner and in compliance with the technical requirements, in conformity with the need, and to make sure that it currently functions properly.
The report groups all information concerning the place at which and the conditions under which the test was performed.

Example of a Report of on-site measurement on the tests performed

INSTALLATION MEASUREMENT FILE

Photovoltaic installation at: PADJORY Ltd
Rain Hill Road
CHELMSFORD (Essex)

Measurement date: 10/04/2010

INSTALLATION RATED POWER: 4 kW

ATMOSPHERIC MEASUREMENTS

Irradiance: 604.87 W/m²

Ambient temp.: 24.67 °C NOCT: 40 °C

Module temp.: 25.08 °C Gamma: 0.55

Temp. coeff.: 0.85

THEORETICAL AVAILABLE POWER [kW]: 2.42

DC ELECTRICAL MEASUREMENTS

V1: 269.4 V I1: 4.2 A

V2: 270.2 V I2: 4.3 A

DC POWER: 2.3 kW

AC ELECTRICAL MEASUREMENTS

V1: 237 V I1: 7.6 A

AC POWER: 2.09 kW

MEASUREMENT RESULTS

MANEL EFFICIENCY: 95.2 %

INVERTER EFFICIENCY: 90.9 %

PANEL EFFICIENCY: Pcc > 0.85 * Pnated * I / ISTC

- Pp-p is the power (in kW) measured at the photovoltaic generator's output, with an accuracy greater than 2%;
- Pnated is the rated power (in kW) of the photovoltaic generator;
- I is the irradiance (in W/m2) measured in terms of modules, with an accuracy greater than 3%;
- ISTC, which is 1000 W/m2, is the irradiance in standard conditions;

INVERTER EFFICIENCY: Pca > 0.9 * Pp-p

- Pca is the active power (in kW) measured at the inverter output, with an accuracy greater than 2%;

10. TECHNICAL CHARACTERISTICS OF THE INSTRUMENT

WARNING, DANGER!
Reference conditions: 23℃ ±3℃; 45-75%

MONITOR	High-luminosity digital colour LCD	
display area	5,7" (diagonal).	
resolution	320 (W) x 240 (H) pixels.	
contrast factor	300:1	
luminosity	400cd/m^2.	
Surface treatment	anti-glare and hard coating (>2H).	
visual angle	±55°(horizontal), ±60°(vertical).	
PYRANOMETER	probe measuring the insolation Range 0 ÷ 2000W/m², accuracy ±2% over any the whole measurement range according to the manufacturer's certification Other characteristics according to the manufacturer's manual provided with the device	
AMBIENT TEMPERATURE	PT100 probe measuring the ambient temperature Range -30 ÷ +80℃ Accuracy ± 1% ± 1℃ from 0 to +80℃	
TEMPERATURE OF THE SOLAR PANELS	PT100 probe measuring the temperature of the solar panels Range -30 ÷ +120℃ Accuracy ± 1% ± 1℃ from 0 to +90℃ **CHECK THAT THE PANEL IS CLASS II** **BEFORE PLACING THE TEMPERATURE PROBE**	
DC VOLTMETER CAT IV 600 V	3 inputs for the simultaneous measurement of the output voltages of 3 solar panels 1000V_{DC} full scale - accuracy ± 1% from 10 to 1000V_{DC}	
DC AMMETER Use a **CAT III 600 V class II** clamp	3 inputs for the simultaneous measurement of the output current of 3 solar panels	
	PAC10-FTV clamp	200A_{DC} full scale - accuracy ± 1% from 2 to 200A_{DC}
	PAC20-FTV clamp **(with the dedicated instrument only)**	1400A_{DC} full scale - accuracy ±1% from 5 àto1400A_{DC}
AC VOLTMETER CAT IV 600	3 inputs for the simultaneous measurement of the voltages of three-phase lines with or without neutral (use input 1 for single-phase lines) 600V_{AC} 50Hz full scale - accuracy ±1% from 80 to 600V_{AC}	
AC AMMETER Use a **CAT III 600 V class II** clamp	3 inputs for the simultaneous measurement of the currents of three-phase lines (use input 1 for single-phase lines)	
	MN-FTV mini-clamp	200A_{AC} full scale - accuracy ±1% from 2 to 200A_{AC}
	C107-FTV clamp **(with the dedicated instrument only)**	1000A_{AC} full scale - accuracy ±1% from 5 to 1000A_{AC}
	D43-FTV clamp **(with the dedicated instrument only)**	3000A_{AC} full scale - accuracy ±1% from 5 to 3000A_{AC}
AC/DC POWER	accuracy < 2%	
CALCULATION FUNCTIONS	efficiency of the photovoltaic panels with compensation for the temperature coefficient of the modules inverter conversion efficiency	
DATA RECORDER	memory, including: customer permanent data, characteristics of the system, measurements and test results Each of the **20 sites** can acquire up to **12 measurement reports** (certifications).	
COMMUNICATION PORT	RS232 + USB for management of the boards and transfer of the data to a PC	
INTERNAL POWER SUPPLY	Li-Ion battery pack, 4.5Ah, 8h life between charges	
MAINS POWER SUPPLY	by external power supply unit 220V_{AC} - 50Hz, 115VA, output 14.5-16V_{DC}	

OPERATING TEMPERATURE	From 5℃ to +40℃.
USE	The device must not be used in the rain with the cover open
MAXIMUM ALTITUDE OF OPERATION	2000m.
RELATIVE HUMIDITY	80% UP TO 40℃ (LINEAR DECREASE TO 50% AT 50℃).
STORAGE TEMPERATURE	From -10℃ to +60℃.
PROTECTION	protection index IP54 (with cover closed)
DIMENSIONS	360 x 30 x 194mm
MASS	3KG (WITH BATTERY)

11. CHARACTERISTICS OF THE REMOTED MODULE

WARNING, DANGER!

The use of the remoted module allows the simultaneous measurement and display of the atmospheric parameters on the GREEN TEST FTV 100 instrument, even when the panels are at a distance from the inverter.

SERIAL COMMUNICATION PORT	RS232 for real-time communication with the GREEN TEST FTV 100 instrument (using the optional "cable" or "Bluetooth" kit)
POWER SUPPLY	Internal: 4 standard 1.5V alkaline batteries, approximately 20h between charges (without the Bluetooth kit) or 4 1.5V rechargeable batteries (not provided)
SWITCH (1)	On/Off button with mechanical selector
LED INDICATOR (2)	Lit steadily: remoted FTV 100 module with batteries adequately charged Slow flashing: battery life of the remoted FTV 100 module **approximately 30 min. (battery charge level approximately 4.6V)** Rapid flashing: battery life of the remoted FTV 100 module **approximately 10 min. (battery charge level approximately 3.6V). REMARK: we recommend replacing or recharging the batteries immediately when the slow flashing stage is reached. The remaining battery life depends on the type of battery used (alkaline/rechargeable).**
CONNECTION	By 3 FRB connectors for the ambient temperature probe, the panel temperature probe, and the pyranometer
OPERATING TEMPERATURE	from 5℃ to +40℃.
USE	In zones protected from water and rain
MAX. ALTITUDE OF OPERATION	2000m.
RELATIVE HUMIDITY	80% UP TO 40℃ (LINEAR DECREASE TO 50% AT 50℃).
STORAGE TEMPERATURE	from -10℃ to +60℃.
DIMENSIONS	85 x 60 x 150mm
MASS	500G (WITH BATTERY)

11.1 PROCEDURE FOR CONNECTION AND CONFIGURATION OF THE REMOTED FTV 100 MODULE

1. Connect the probes of the unit (temperature and insolation) to the corresponding inputs of the remoted module (see photograph A)

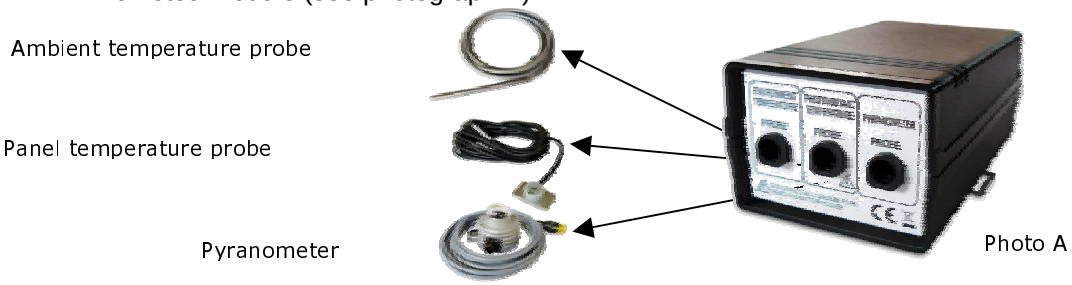


Photo A

2. Connect one of the Bluetooth units (a) or the RS232 connector (b) of the serial cable (if one is provided); see photograph B

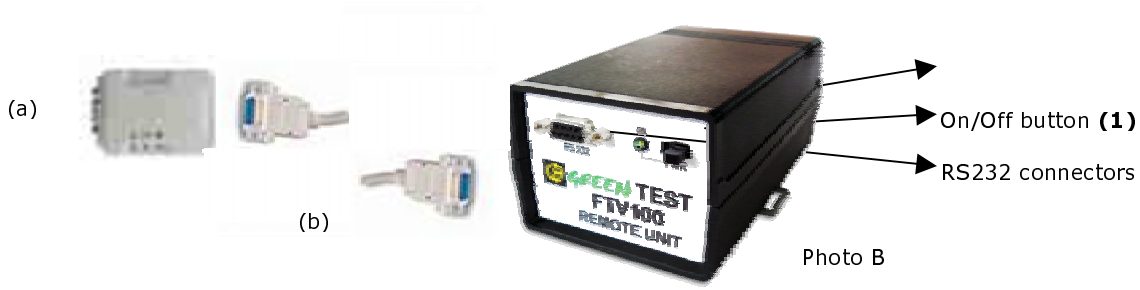


Photo B

3. Connect the GREEN TEST instrument to the other Bluetooth unit or to the RS232 connector of the serial cable (if one is provided).
4. Power up the remoted module using the On/Off button (the LED indicators confirm the power up and the presence of a power supply provided by the batteries).
5. Follow the instructions (see the REMOTE MEASUREMENT MENU) for activation of communication with the instrument.

12. TECHNICAL CHARACTERISTICS OF THE "BLUETOOTH" COMMUNICATION KIT

The Bluetooth kit is used to transmit the atmospheric parameters from the remoted module to the GREEN TEST FTV 100 instrument when the panels are placed at a distance from the inverter.

I/O INTERFACE	Master unit and slave unit, already programmed, RS232 ports for the real-time communication interface with the GREEN TEST FTV 100
POWER SUPPLY	by RS232 or mains adapter $230V_{AC}$ (5…7,5V)
POWER SUPPLY FOR THE BLUETOOTH SIGNAL	**The minimum power supply provided by the remoted module for communication between Bluetooth adapters is approximately 4.6V, roughly equivalent to the low charge level of the battery (slow flashing of the red indicator on the remoted module).** ***REMARK: in this case, we advise immediately replacing or recharging the batteries.***
TRANSMISSION	Bluetooth v2.0 + EDR
FREQUENCY	2.4…2.4835GHz, ISM licence
SPECTRUM	FHSS
RF OUTPUT POWER	Class 1
DISTANCE	100m - **in free field**
OPERATING TEMPERATURE	from 0°C to +60°C.
USE	In zones protected from water and rain
MAXIMUM ALTITUDE OF OPERATION	2000m
RELATIVE HUMIDITY	90% up to 40°C
STORAGE TEMPERATURE	from -10°C to +70°C.
DIMENSIONS	76 x 62 x 20mm
MASS	approximately 50g

Other characteristics according to the manufacturer's manual provided

The optional Bluetooth adapters are of the highest quality, with the best characteristics and performance available on the market.
Even so, some situations may induce perturbations and interfere with communication.
In these situations, we suggest moving the Bluetooth adapter (connected to the instrument by a cable of sufficient length fitted with the two male/male RS232 connectors supplied with the remoted module).

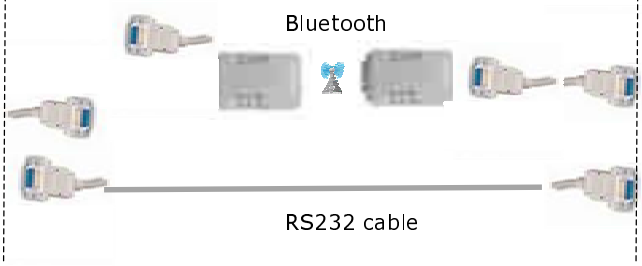
13. TECHNICAL CHARACTERISTICS OF THE "CABLE" KIT

The RS232 cable communication kit allows the transmission of the atmospheric parameters to the GREEN TEST FTV 100 instrument by the remoted module, by means of a physical connection, when the panels are placed at a distance from the inverter.

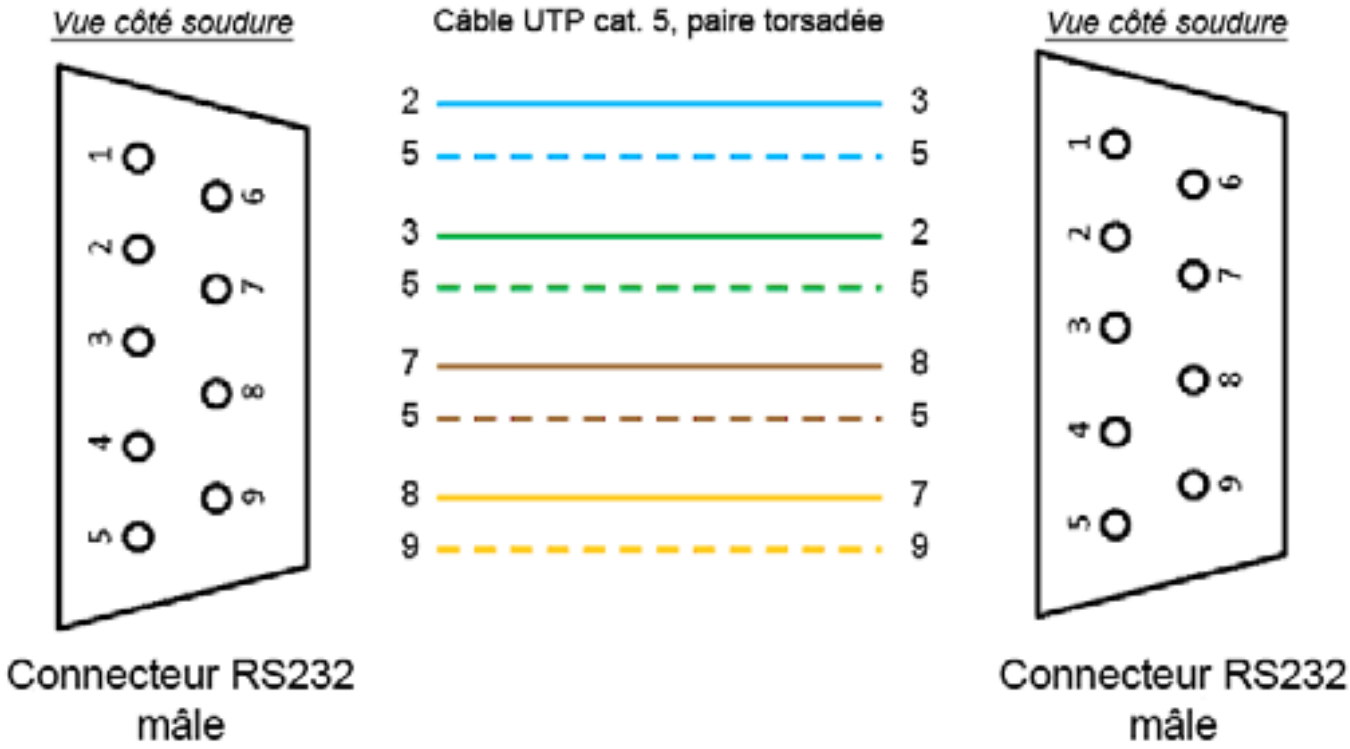
TYPE	Minimum requirements: UTP Cat.5 cable, twisted pair
LENGTH	15m standard (the male RS232 connectors should be soldered if the length is greater).
CONNECTION	Male/male RS232 connectors

13.1 PROCEDURE FOR CONNECTION AND CONFIGURATION OF THE "BLUETOOTH" OR "RS232 CABLE" COMMUNICATION KIT

1. Connect one of the two Bluetooth units or the RS232 connector (b) of the serial cable (if one is provided) to the remoted module
2. Connect one of the two Bluetooth units or the RS232 connector (b) of the serial cable (if one is provided) to the GREEN TEST unit.
3. Power up the remoted module using the On/Off button (the LED indicators confirm the power up and the presence of a power supply provided by the batteries).
4. Follow the instructions (see the REMOTE MEASUREMENT MENU) for activation of communication with the instrument.
5. Check that the blue indicator of the Bluetooth unit is lit, confirming that communication is active.

Instrument	Transmission	Remoted module	Probes
			

14. PRODUCING A CABLE USING THE RS232 CONNECTORS PROVIDED WITH THE OPTIONAL REMOTED FTV 100 MODULE



15. TECHNICAL CHARACTERISTICS OF THE PYRANOMETER

WARNING, DANGER!

The user must take care not to connect the metallic parts of the pyranometer to a hazardous voltage.

15.1 INTRODUCTION

The LP PYRA 03 pyranometer measures the insolation on a plane surface (W/m²). The insolation measured is the sum of the direct solar radiation and the diffuse radiation (total radiation).

15.2 OPERATING PRINCIPLE

The operation of the LP PYRA03 pyranometer is based on a thermopile sensor. The sensitive zone of the thermopile is covered by a thin coat of black paint to make the response of the pyranometer to different wavelengths unselective. The spectral band of the pyranometer is determined by the emission of a K5 type glass dome.
The radiant energy is absorbed by the blackened surface of the thermopile, creating a temperature difference between the centre of the thermopile (hot junction) and its body (cold junction). The temperature difference between the hot and cold junctions is converted into a difference of potential by the Seebeck effect.

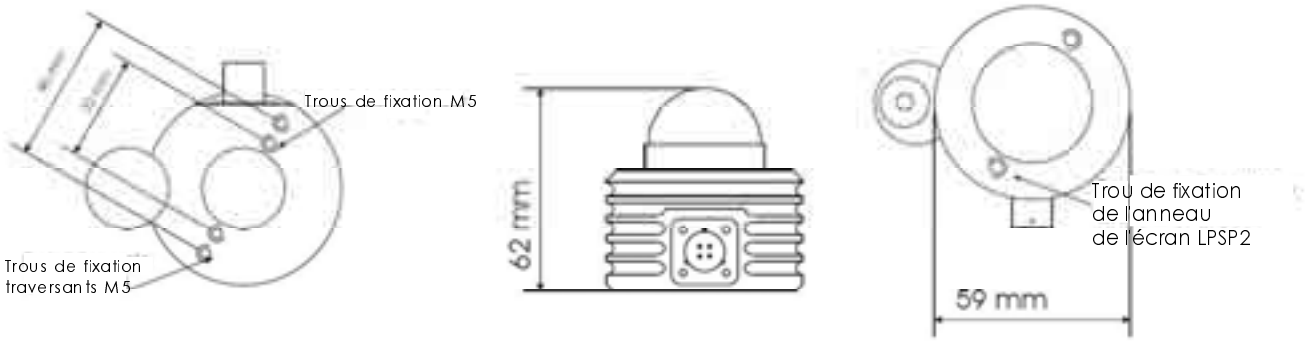
The LP PYRA 03 has a dome having an outside diameter of 32mm, 4mm thick, in order to ensure adequate thermal insulation of the thermopile against the effects of wind and to reduce its sensitivity to thermal radiation. The dome also protects the thermopile from dust, which could otherwise modify the spectral sensitivity by accumulating on the blackened part.
To prevent the formation of condensation on the inside of the dome in certain particular climatic conditions, the pyranometer contains sachets of silica gel to absorb moisture.

15.3 INSTALLATION AND ASSEMBLY OF THE PYRANOMETER

- The pyranometer should be installed at a place where no buildings, trees, or other obstacles mask the horizon. When this is impossible, we recommend choosing a location where obstacles on the path of the rising and setting sun protrude less than 5° above the horizon.

N.B.: *the presence of obstacles on the horizon significantly influences the direct insolation measurement.*

- The pyranometer must be placed away from any obstacle that might reflect sunlight (or shade).



Example of positioning of the pyranometer

15.4 TECHNICAL CHARACTERISTICS

TYPICAL SENSITIVITY	10μV/(W/m^2)
IMPEDANCE	33Ω ÷ 45Ω
MEASUREMENT RANGE	0-2000W/m^2
MEASUREMENT ACCURACY*	1.5% typical
RESPONSE TIME	<30s
FIELD OF VISION	2 Π sr
SPECTRAL BAND	305nm ÷ 2800nm (50%)
TRANSMISSION OF THE DOME	335nm ÷ 2200nm (95%)
OPERATING TEMPERATURE	-40℃ ÷ 80℃
MASS	0,45kg
SAFETY	EN 61000-4-2, EN 61010-1, level 3
ELECTROSTATIC DISCHARGES	EN 61000-4-2, level 3
VOLTAGE VARIATION	EN 61000-4-3
EMC	IEC 1000-4-3, EN 55020 class B

* Environmental conditions 23℃ ± 2% - RH 50% ±10%

16. WARRANTY

The instruments we manufacture are guaranteed for twelve months against malfunctions due to defective workmanship or materials.
To make a claim under the warranty, you must produce a copy of the invoice or of the receipt for the purchase of the instrument.
The warranty does not apply in the following cases:

- Inappropriate use of the equipment or use with incompatible equipment;
- Modifications made to the equipment without the explicit permission of the manufacturer's technical staff;
- Work done on the device by a person not approved by the manufacturer;
- Adaptation to a particular application not anticipated in the definition of the equipment or not indicated in the user's manual;
- Damage caused by shocks, falls, or floods.

The batteries are not covered by the warranty.

17. MAINTENANCE

For maintenance, use only the specified spare parts. The manufacturer cannot be held liable for any accident that occurs following a repair done by a party other than Chauvin-Arnoux customer service or an approved repairer.

17.1 CLEANING

To ensure a highly accurate measurement, the outside of the dome must be kept clean at all times. The more often the dome is cleaned, the more accurate the measurement. The cleaning can be done using ordinary camera lens cleaning tissue and water or, if this is not sufficient, pure ethanol. After cleaning with alcohol, the dome must be rinsed with plain water.

17.2 METROLOGICAL CHECKS

Like all measuring and testing devices, the instrument must be checked periodically.

Each pyranometer is individually calibrated in the plant and marked with its calibration factor. For best results with the pyranometer, we recommend an annual check of the device. For checks and calibrations, get in touch with our COFRAC-accredited metrology laboratories or with a MANUMESURE agency.

Information and contact data on request:
Tel.: 02 31 64 51 43 Fax: 02 31 64 51 09

17.3 REPAIRS

For repairs under the warranty, send your device to one of the CHAUVIN-ARNOUX-approved MANUMESURE regional agencies.

Information and contact data on request:
Tel.: 02 31 64 51 43 Fax: 02 31 64 51 09

For repairs outside metropolitan France, whether or not under warranty, send the device to your distributor.

18. TO ORDER

GREEN TEST FTV 100.....P01160700

THE instrument is provided with:

- A carrying case containing the instrument;
- 1 pyranometer for solar radiation + connecting cable;
- 1 Pt100 probe for the ambient temperature;
- 1 Pt100 probe for the temperature of the panels;
- 3 MN13-FTV current clamps for measurement of the alternating current;
- 1 PAC10-FTV current clamp for measurement of the direct current;
- 4 sets of 3m leads (red/black);
- 4 pairs of test probes (red/black);
- 1 4.5Ah Li-Ion battery + power supply unit;
- Data transfer software + USB cable;
- Carrying bag for the accessories;
- Operating manual in French and English.

MEASUREMENT KIT FOR THREE-PHASE SYSTEM P01160710

For the measurement of 3 chains of panels, comprising:

- 2 PAC10-FTV current clamps for measurement of the direct current;
- 2 sets of 3m leads (red/black);
- Pairs of test probes (red/black).

P01160720

The instrument is provided with:

- A carrying case containing the instrument;
- 1 pyranometer for solar radiation + connecting cable;
- 1 Pt100 probe for the ambient temperature;
- 1 Pt100 probe for the temperature of the panels;
- 3 MN13-FTV current clamps for measurement of the alternating current;
- 3 PAC10-FTV current clamp for measurement of the direct current;
- 6 sets of 3m leads (red/black);
- 6 pairs of test probes (red/black);
- 1 4.5Ah Li-Ion battery + power supply unit;
- Data transfer software + USB cable;
- Carrying bag for the accessories;
- Operating manual in French and English.

ACCESSORIES (OPTIONS)

- REMOTED FTV 100 MODULE + 2 male/male RS232 connectors..... **P01160736**
- Bluetooth communication kit (transmitter/receiver)..... **P01160738**
- Serial cable with male/male RS232 connectors..... **P01160737**
- RS232/USB adapter..... **HX0055**

SPARE PARTS

- 1 pyranometer for solar radiation + connecting cable **P01160730**
- 1 Pt100 probe for the ambient temperature **P01160731**
- 1 Pt100 probe for the temperature of the panels **P01160732**
- PAC10 – FTV clamp for GREEN TEST **P01160734**
- MN13 – FTV clamp for GREEN TEST **P01160733**
- PAC20 – FTV clamp **P01120092**
- C 107 – FTV clamp **P01120100**
- D 43 – FTV clamp **P01120337**
- Li-Ion battery **P01160735**
- Set of 4mm test probes (R/B) **P01102051Z**
- Set of 3m cords (R/B) (straight connectors)..... **P01295097**
- Set of 4mm alligator clips (R/B)..... **P01102052Z**

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DEUTSCHLAND - Chauvin Arnoux GmbH
Straßburger Str. 34 - 77694 Kehl / Rhein
Tel: (07851) 99 26-0 - Fax: (07851) 99 26-60

ESPAÑA - Chauvin Arnoux Ibérica S.A.
C/ Roger de Flor N°293, Planta 1- 08025 Barcelona
Tel: 902 20 22 26 - Fax: 934 59 14 43

ITALIA - Amra SpA
Via Sant'Ambrogio, 23/25 - 20050 Bareggia di Macherio (MI)
Tel: 039 245 75 45 - Fax: 039 481 561

ÖSTERREICH - Chauvin Arnoux Ges.m.b.H
Slamastrasse 29/3 - 1230 Wien
Tel: 01 61 61 961-0 - Fax: 01 61 61 961-61

SCANDINAVIA - CA Mätsystem AB
Box 4501 - SE 18304 TÄBY
Tel: +46 8 50 52 68 00 - Fax: +46 8 50 52 68 10

SCHWEIZ - Chauvin Arnoux AG
Moosacherstrasse 15 – 8804 AU / ZH
Tel: 044 727 75 55 - Fax: 044 727 75 56

UNITED KINGDOM - Chauvin Arnoux Ltd
Unit 1 Nelson Court – Flagship Square-Shaw Cross Business ParkDEWSBURY – West Yorkshire – WF12 7THTel : 011628 788 888 – Fax : 01628 628 099

MIDDLE EAST - Chauvin Arnoux Middle East
P.O. BOX 60-154 - 1241 2020 JAL EL DIB (Beirut) - LEBANON
Tel: (01) 89 04 25 - Fax: (01) 89 04 24

CHINA - Shanghai Pu-Jiang - Enerdis Instruments Co. Ltd
3 F, 3 rd Building - N°381 Xiang De Road - 200081 SHANGHAI
Tel: +86 21 65 21 51 96 - Fax: +86 21 65 21 61 07

USA - Chauvin Arnoux Inc - d.b.a AEMC Instruments
200 Foxborough Blvd. - Foxborough - MA 02035
Tel: (508) 698-2115 - Fax: (508) 698-2118

http://www.chauvin-arnoux.com

190, rue Championnet - 75876 PARIS Cedex 18 - FRANCE
Tel.: +33 1 44 85 44 85 - Fax: +33 1 46 27 73 89 - info@chauvin-arnoux.fr
Export: Tel.: +33 1 44 85 44 86 - Fax: +33 1 46 27 95 59 - export@chauvin-arnoux.fr